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(54) Rotary printing press with an integrated image-setter comprising a hollow transparent cylinder as exposure drum

(57) The image-setter is a hybrid drum type which combines the advantages of internal and external drum image-setters and which provides a solution for protecting the opto-mechanical devices from contamination by ink, fountain, processing and cleaning liquids, etc. The printing press comprises a hollow transparent cylinder 110 for carrying on its outer surface an imaging element 150. A radiation beam 161 is projected by deflecting means 160 located inside said hollow cylinder 110 through transparent cylinder wall 111 towards imaging element 150. After exposure and optional development a master is obtained. Ink applied onto the printing surface 151 of said master is then transferred to a substrate 170. The imaging element is preferably provided by coating a radiation sensitive composition onto the outer surface of said hollow transparent cylinder using coating means 140.

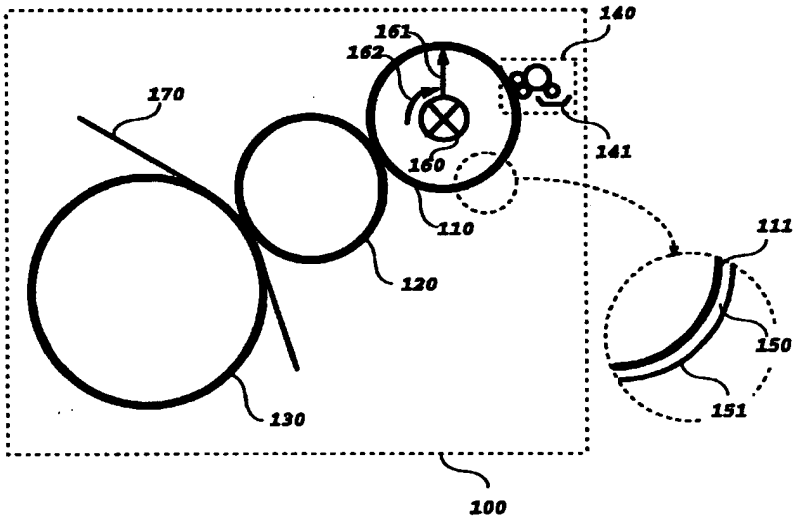

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a rotary printing press having an integrated image-setter.

BACKGROUND OF THE INVENTION

[0002] Rotary printing presses use a so-called master such as a printing plate which carries an image and is mounted on a cylinder of the printing press. The image is defined by ink accepting areas of the master and a print is obtained by applying ink to the master and then transferring the ink from the master onto a (paper) substrate.

[0003] Masters are generally obtained by the so-called computer-to-film method (CtF) wherein various pre-press steps such as typeface selection, scanning, colour separation and layout are accomplished digitally and the electronic files are transferred to graphic arts film using an image-setter (one film per process colour). The processed film then can be used as a mask for the exposure of an imaging element called plate precursor and after optional plate processing, a printing plate is obtained.

[0004] In recent years the so-called computer-to-plate method has gained a lot of interest. This method, also called direct-to-plate method, bypasses the creation of film and the digital document is transferred directly to a plate precursor. In a special type of a computer-to-plate process, sometimes called 'computer-to-press', a plate precursor is exposed while being mounted on a plate cylinder of a printing press by means of an image-setter that is integrated in the press. Printing presses with an integrated image-setter are sometimes called digital presses. An overview of digital presses is given in the Proceedings of the Imaging Science & Technology's 1997 International Conference on Digital Printing Technologies (Non-Impact Printing 13).

[0005] Image-setters of the so-called drum type are known in two configurations. In the internal drum (ITD) image-setters a light sensitive material is held against the inside concave surface of a stationary drum with the light sensitive surface facing towards the axis of the drum. A typicical internal drum's surface is not completely cylindrical but 180-270° of a cylinder's normal 360°. The light sensitive material is line-wise exposed by means of a rotating deflector which projects a modulated axial laser beam at right angles onto the surface of the sheet. The deflector and its driving motor are mounted on a carriage which can travel axially through the drum. Disadvantages of this type of apparatus are the generation of stray light and reflections in the drum and the need for complex and expensive sheet handling mechanisms for loading and unloading the light sensitive material, in particular when relatively stiff sheets such as aluminium printing plates are used in drums having a small diameter.

[0006] In external drum (ETD) image-setters a light sensitive material is supported by the outer surface of a rotating cylinder with the light sensitive surface facing away from the drum. A modulated laser beam is projected perpendicularly to said light sensitive surface while being scanned parallel to the axis of the cylinder. A major drawback of ETD image-setters is the limited rotational speed because of the high inertia of the drum. A typical rotational speed of ETD film-setters is about 2,000 rpm compared to 10,000-30,000 rpm in ITD devices. ETD plate-setters are even slower (around 150 rpm) due to the lower sensitivity of a printing plate precursor compared to film, thus requiring multiple beams (from ten up to a few hundred) in order to achieve a reasonable exposure time. The concept of multiple-beam imaging however may cause the well-known artefact of banding due to a variable overlap between individual beams. In addition, ETD image-setters are less compact than ITD's.

[0007] In spite of these drawbacks, ETD configurations do not suffer from the above mentioned disadvantages associated with an ITD configuration. In addition, the light sensitive material may be held firmly on the outer surface of the ETD by clamps or other mechanisms whereas ITD usually requires vacuum as means for supporting the material. Whether to use an ITD or ETD is a hotly debated topic in platesetting. For a further in-depth discussion on the comparative advantages and disadvantages of each configuration, reference is made to "Computer-to-Plate : Automating the Printing Industry", Graphic Arts Technical Foundation, Pittsburgh (1996), p. 220-236.

[0008] In the field of film-setting, ITD devices are rapidly becoming the most popular machines for high quality imaging because of the constant optical path which offers very precise control over dot shape and intensity and the lack of vibrations during exposure as the drum is not rotating. In spite of these benefits, ITD image-setter are not compatible with on-press imaging because of the evident requirement that the master must be supported by the outer surface of a cylinder in order to be able to apply ink to said master. Therefore all digital presses known today comprise an integrated ETD image-setter, examples of which are disclosed in e.g. EP-A 802,457 and DE-A 4,313,111. In such presses a printing plate is mounted on the outer surface of the exposure drum, which may be the plate cylinder, and after exposure by the ETD image-setter and optional processing, a master having a printing surface is obtained. Then ink and optionally a dampening liquid (in lithographic printing) is applied onto the printing surface.

[0009] In addition to the above mentioned characteristics, a major problem associated with the use of ETD image-setters in digital printing presses is the high risk of contamination of the laser and other optical and mechanical devices necessary for modulating, focussing and scanning the laser beam. Contamination

sources that may jeopardise the proper functioning of these devices are abundant in printing presses, e.g. ink, dampening liquid, cleaning solvents, processing solutions, dust and paper fibres.

SUMMARY OF THE INVENTION

[0010] It is an object of the present invention to provide a rotary printing press with an integrated drum type image-setter that is characterised by a high rotational speed, a compact design and a high image quality as indicated above for ITD image-setters but without the need for complex mechanisms for sheet handling and holding. It is also an object of the present invention to offer a solution for preventing contamination of the opto-mechanical devices of an image-setter which is integrated in a rotary printing press. These objects are realised by the rotary printing press having an integrated image-setter as defined in claim 1. The specific features of claim 1 define a hybrid drum type image-setter having both the advantages of ITD and ETD image-setters.

[0011] It is also an object of the present invention to provide a method for on-press imaging of a master by using a rotary printing press with an integrated drum type image-setter having the above mentioned advantages. This object is realised by the method of claim 6. The master thus obtained may be used for printing as defined by claim 13.

[0012] Specific features of preferred embodiments of the invention are disclosed in the dependent claims. Further advantages and embodiments of the present invention will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 shows an embodiment of a print station of a rotary printing press with integrated image-setter according to the present invention.

Fig. 2 shows another embodiment of a print station of a rotary printing press with integrated image-setter according to the present invention.

Fig. 3 shows a very compact embodiment of a four-colour rotary printing press having a single integrated image-setter according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The rotary printing press of the present invention is preferably an offset lithographic press, wherein the ink is transferred from a master, which is carried by a master cylinder, to a blanket cylinder and then from the blanket cylinder to a substrate which is pressed against the blanket cylinder by an impression cylinder. The term "master" defines an element having a printing surface, i.e. an image carrying surface of which some areas are capable of accepting ink (the printing areas). In lithographic printing, said printing surface is a so-called lithographic surface consisting of oleophilic, ink accepting areas and oleophobic, ink repellent (non-printing) areas. In so-called wet lithography, the non-printing areas are moistened by the application of a dampening liquid, also called fountain solution. Alternatively, the rotary printing press of the present invention may be a driographic press. Driographic printing is a lithographic technique which does not require the use of a dampening liquid. The present invention may also be carried out in the field of other printing techniques such as letterpress printing wherein the ink is transferred from the master directly to the substrate without an intermediate cylinder such as the blanket cylinder.

[0015] One embodiment of the present invention is illustrated in Figure 1, showing a print station 100 of an offset lithographic rotary press according to the present invention. The print station 100 comprises a master cylinder 110, a blanket cylinder 120 and an impression cylinder 130. In the embodiment of Figure 1 the master cylinder 110 is used as exposure drum of the integrated image-setter for carrying an imaging element 150 that is capable, after image-wise exposure and optional development, of becoming a master having printing surface 151. Master cylinder 110 is hollow and its wall 111 is made of material which is transparent with respect to radiation beam 161. Hollow cylinder 110 encloses deflecting means 160 for projecting radiation beam 161 over the inner surface of cylinder 110 as indicated by arrow 162 and through transparent wall 111. The feature "transparent with respect to the radiation beam" may be referred to herein briefly as "transparent" and means that the transmittance of radiation is sufficient so as to obtain after exposure and optional processing a printing surface on the imaging element, which is sensitive to said radiation. The print station of the present invention also comprises means for applying ink (not shown in Figure 1) onto the printing surface 151 of the master and may optionally comprise means for applying a dampening liquid. The ink is transferred from printing surface 151 to substrate 170 via blanket cylinder 120.

[0016] The imaging element may be a printing plate precursor comprising a support. If said support is located between the exposure drum and the radiation sensitive layer, then said support should also be transparent in order to be able to expose the radiation sensitive layer of the imaging element. As explained in more detail below, the transparent support of such a plate is preferably a thin glass support.

[0017] In a highly preferred embodiment of the present invention, the imaging element is not provided on the hollow transparent cylinder as a printing plate precursor comprising a support, but by coating a radiation sensitive composition onto the outer surface of said cylinder, e.g. by using coating means 140. Details of suitable coating liquids and coating means are given

below.

[0018] In still another embodiment of the present invention, the radiation sensitive layer of a plate precursor comprising a support may be laminated onto the exposure drum. After lamination said support, which may be non-transparent, can be stripped away (before or after exposure), leaving the radiation sensitive layer on the exposure drum in such a way that the printing surface obtained after exposure and optional development, is facing away from the exposure drum. The lamination method may be facilitated by the use of a reversible adhesive layer to adhere the radiation sensitive layer to the exposure drum and/or by applying heat or pressure to the laminate. Suitable examples of reversible adhesion layers are described in e.g. EP-A 807,534. An example of a plate precursor which is suitable for use in the latter embodiment is described further below.

[0019] The present invention also provides another solution for on-press exposing a printing plate precursor having a non-transparent support with an integrated image-setter according to the present invention. The embodiment of Figure 2 is distinguished from the above by the feature that the transparent exposure drum and the master cylinder are different elements. The print station in Figure 2 comprises an additional cylinder 210 used as hollow transparent exposure drum comprising deflecting means 211, defined herein by the term "imaging cylinder". Said imaging cylinder 210 may be provided with a printing plate precursor 250 having a non-transparent support 251 and a radiation sensitive layer 252 on the side of the support that is facing the drum 210 (thickness of layers 251 and 252 not drawn to scale). As indicated by arrows 290, plate 250 may be transported from imaging cylinder 210 to master cylinder 220 after image-wise exposure in such a way that the printing surface 253 of the plate is facing away from the master cylinder 220. In Figure 2 imaging cylinder 210 is in rotatable contact with master cylinder 220 though it is obvious that other embodiments with more complex plate transport mechanisms are also possible. The other elements indicated in Figure 2 are a blanket cylinder 230 and a segment of an impression cylinder 240 (means for applying ink or dampening liquid not shown).

[0020] As a further alternative to the embodiment of Figure 2, the image-setter may be integrated in another cylinder of the print station, e.g. impression cylinder 240. After image-wise exposure the printing plate precursor may then be transported from that cylinder to master cylinder 220. In this way there is no need to use an additional cylinder as exposure drum.

[0021] The press of the present invention may be used for black and white printing or multi-colour printing. In the latter case a plurality of print stations may be used in a so-called in-line configuration comprising sequential print stations, one for each process colour. Alternatively, a plurality of print stations comprising a master cylinder and a blanket cylinder may be sharing a single large diameter impression cylinder, called central impression cylinder, as described in US 4,936,211 and EP-A 771,646 or a segmented central impression cylinders as described in EP-A 751,875, which upon combination with segmented plate and blanket cylinders allows to apply more than one colour to the same plate cylinder.

[0022] An example of a configuration with a central impression cylinder is illustrated by Figure 3. This embodiment of the present invention has a very compact design achieved by combining the concept of a central impression cylinder with the concept of the impression cylinder being the transparent exposure drum that is common to all print stations. The embodiment of Figure 3 has four print stations, each comprising a master cylinder 310 and a blanket cylinder 320 located around a common central impression cylinder 330, which also is the transparent exposure drum of a common integrated image-setter comprising deflecting means 331. Adjacent segments of the outer surface of central impression cylinder 330 may hold the individual printing plate precursors, each corresponding to one colour separation. After simultaneous exposure of all said colour separations, the plates then may be transported from central impression cylinder 330 to the individual master cylinders 310. Equivalent to the embodiments above, this compact embodiment may be used with plates having transparent or non-transparent supports and the method of transporting the plates from impression cylinder 330 to master cylinder 310 may be adapted accordingly so as to obtain in every such case a printing surface facing away from the master cylinder 310.

[0023] As mentioned above, the transparent hollow cylinder is the exposure drum of an integrated image-setter. Said transparent hollow cylinder is preferably made of glass or a glass ceramic. Transparent hollow cylinders for supporting an imaging element have been described previously. US 5,045,697 describes a system for making a print master on a transparent hollow cylinder by means of a thermal transfer process using a thermal recording head which selectively transfers heat meltable particles to the outer surface of said transparent hollow cylinder. The transparent hollow cylinder comprises an infrared light source which is not used for image-wise exposing an imaging element (source is not modulated) but for heating the cylinder to facilitate the transfer process.

[0024] EP-A 571,149 describes an image-setter comprising a transparent hollow semi-cylinder as exposure drum wherein a laser beam is projected by deflecting means located within said semi-cylinder towards an imaging element carried by the outer surface of said semi-cylinder. However said image-setter is used for exposing sheets of graphic arts film and is not suitable for making a plate master in a printing press because it is an essential featur of that apparatus that the radiation sensitive layer is facing the cylinder and no solution

is provided for having a printing surface after exposure and optional processing that is facing away from the cylinder so that ink can be applied onto said surface.

[0025] In the methods of the present invention, the radiation beam may be generated by a light source of which the wavelength matches the spectral sensitivity of the imaging element. A light emitting diode may be used as well as a laser such as an argon laser, helium-neon laser and semiconductor laser, e.g. NdYAG or a laser diode. Infrared lasers are highly preferred.

[0026] The radiation beam generated by said light source may be expanded, collimated and modulated with image information in conventional manners known by the skilled person. The radiation beam is focussed substantially on the radiation sensitive layer of she imaging element by a focussing lens. The deflecting means typically comprises a rotatably mounted reflector, which may be a mirror or a prism, and means for causing a lateral movement along the axis of the exposure drum. The rotatable reflector may be driven by a motor. At very high rotation speeds it may become necessary to use expensive air bearings, which can be obviated by using a multi-facet reflector to project simultaneously multiple scanlines per revolution.

[0027] Since the transparent wall of the exposure drum may act like a large radius cylindrical lens, some astigmatism may be caused in the focussed spot. This effect may be compensated by mounting a cylindrical lens before or after the reflector.

[0028] Preferably all opto-mechanical devices (laser, optics, motor, etc.) are mounted on a common carrier which can be moved axially in the exposure drum. In another embodiment some devices, e.g the laser source, may be mounted outside the exposure drum thereby allowing easy access for maintenance or adjustment. If mounted outside the exposure drum, the devices are preferably shielded from contamination sources associated with a printing press. The devices which are mounted inside the exposure drum are protected from contamination as such by the exposure drum itself.

[0029] In addition to the above opto-mechanical devices, the rotary printing press of the present invention may also contain the necessary electronics, such as a pixel clock to determine the modulation period of the exposing beam, a controller for controlling the motor speed, a beam detector of which the output is fed to other control components of the image-setter, a raster image processor etc. More details of such electronic devices may be found in e.g. EP-A 571,149.

[0030] In a highly preferred embodiment of the present invention, the imaging element is provided on the outer surface of the exposure drum by coating a radiation sensitive solution onto said surface. Means for applying a uniform coating to the exposure drum include e.g. a spray coater but preferably comprises a train of rolls for supplying coating liquid to th exposure drum to form a uniform coating thereon. An example of such a train of coating rollers is illustrated by coating means 140 in Figure 1. Coating means 140 comprises a container 141 holding a coating liquid and rolls for supplying coating liquid to exposure drum 110. Figure 1 illustrates a roller train consisting of 4 rollers, it is however clear that the number of rollers may vary in number, size, diameter and type of surface. The print station preferably also includes means for moving the coating means to and from the exposure drum so that subsequent to coating said coating means can be moved away allowing for drying of the applied uniform coating. To accelarate drying of the coating heat and/or air may be applied to the coating. The imaging element provided by coating means 140 may consist of a single or a plurality of coated layers. After printing, the coating(s) may be removed e.g. by a brush, a scraper, a water jet, liquid carbon dioxide or an automated solvent wash as is common for cleaning the blanket in a lithographic printing press and is described in e.g. EP-A 446,668

[0031] Coating fluids for use in connection with the present invention may be solvent based though aqueous solutions are preferred. The coating can be photosensitive or preferably heat-sensitive. Photosensitive coatings suitable for use in the present invention are e.g. coatings based on a diazo resin, diazonium salt, aryldiazosulfonate or o-quinone diazide, photopolymerisable or photocurable coatings. Examples of suitable coatings are disclosed in US 3.849.137, Macromolecues 1988, 21, 1475-82, US 4.963.463 and US 5.102.771. Heat sensitive coatings for use in connection with the present invention preferably include a compound capable of converting light into heat. Examples of such compounds are dyes and in particular infrared dyes, carbon black, metal carbides, borides, nitrides, carbonitrides, bronze-structured oxides and oxides structurally related to the bronze family but lacking the A component e.g. $WO_{2.9}$. It is also possible to use a conductive polymer dispersion such as a polypyrrole or polyaniline-based conductive polymer dispersion.

[0032] Upon image-wise exposure, the radiation is locally converted into heat by the above compound and accordingly an image-wise heat pattern is generated in the coating. As a consequence, a physical or chemical change takes place at the heated parts of the coatings which results in an image (optionally after a development step). Various physical and/or chemical changes can be employed. For example the generated heat may induce local cross-linking thereby rendering the coating insoluble at these areas. Alternatively, a coating may be rendered locally hydrophobic thereby causing the exposed areas to be insoluble in an aqueous liquid.

[0033] A particularly preferred coating liquid for use in the present invention is an aqueous liquid comprising a hydrophilic binder, a compound capable of converting light to heat and hydrophobic thermoplastic polymer particles. A coating resulting from such liquid is hydrophilic in nature and can be rendered image-wise hydrophobic through coagulation of the thermoplastic

polymer particles so that development with an aqueous liquid or plain water may result in an image. Suitable hydrophilic binders for use in this embodiment in connection with this invention are for example synthetic homo- or co-polymers such as a polyvinylalcohol, a poly(meth)acrylic acid, a poly(meth)acrylamide, a polyhydroxyethyl(meth)acrylate, a polyvinylmethylether or natural binders such as gelatin, a polysacharide such as e.g. dextran, pullulan, cellulose, arabic gum, alginic acid.

[0034] Hydrophobic thermoplastic polymer particles used in connection with the present invention preferably have a coagulation temperature above 35°C and more preferably above 50°C. Coagulation may result from softening or melting of the thermoplastic polymer particles under the influence of heat. There is no specific upper limit to the coagulation temperature of the thermoplastic hydrophobic polymer particles, however the temperature should be sufficiently below the decomposition of the polymer particles. Preferably the coagulati n temperature is at least 10°C below the temperature at which the decomposition of the polymer particles occurs. When said polymer particles are subjected to a temperature above coagulation temperature they coagulate to form a hydrophobic agglomerate in the hydrophilic layer so that at these parts the hydrophilic layer becomes insoluble in plain water or an aqueous liquid. Specific examples of hydrophobic thermoplastic polymer particles for use in connection with the present invention are e.g. polyethylene, polyvinyl chloride, polymethyl (meth)acrylate, polyethyl (meth)acrylate, polyvinylidene chloride, polystyrene polyacrylonitrile, polyvinyl carbazole etc. or copolymers thereof. Most preferably used is polystyrene. The weight average molecular weight of the polymers may range from 5,000 to more than 1,000,000 g/mol. The hydrophobic thermoplastic particles may have a particle size from 0.01 μm to 50 μm, more preferably between 0.04 μm and 10 μm and most preferably between 0.04 μm and 1 μm. The hydrophobic thermoplastic polymer particles are present as a dispersion in the aqueous coating liquid and may be prepared by the methods disclosed in US-P-3.476.937.

[0035] Another method especially suitable for preparing an aqueous dispersion of the thermoplastic polymer particles comprises:

- dissolving the hydrophobic thermoplastic polymer in an organic water immiscible solvent,
- dispersing the thus obtained solution in water or in an aqueous medium and
- removing the organic solvent by evaporation.

[0036] In addition to the hydrophobic thermoplastic polymer particles, an aqueous coating as described above may include a compound that upon heating causes cross-linking of the hydrophilic binder. In this case a hydrophilic binder should be used that includes reactive groups. Examples of such binders are preferably those that contain reactive groups e.g. hydroxy, amine or carboxyl groups. Specific examples of hydrophilic binders are synthetic homo- or co-polymers such as a polyvinylalcohol, dimethylhydantoine-formaldehyde resin, a poly(meth)acrylic acid, a poly(meth)acrylamide, a polyhydroxyethyl(meth)acrylate, a polyvinylmethylether or natural binders such as gelatin, a polysacharide such as e.g. dextran, pullulan, cellulose, arabic gum, alginic acid. Suitable heat-activatable cross-linking agents for use in a coating liquid in connection with the present invention are preferably compounds that have two or more groups that can react with the hydrophilic binder, e.g. with one of the reactive groups listed above. A cross-linking agent in connection with the present invention may be a low molecular weight compound or may be an oligomer or polymer. Examples of suitable cross-linking agents for use in accordance with the present invention are e.g. aldehydes such as formaldehyde, hexamethoxymethyl melamine, amine-formaldehyde resins such as e.g. melamine-formaldehyde resin or guanamine-formaldehyde resin, dimethylolurea-formaldehyde resins, phenol-formaldehyde resins, compounds having two or more expoxy groups e.g. a polymer having epoxy groups.

[0037] It is preferred to further add a catalyst to a coating liquid in connection with the present invention. Such catalyst will speed-up the cross-linking reaction and accordingly total plate making time can be reduced while maintaining a high level of cross-linking preferred to obtain a high printing endurance. Particularly suitable catalysts for use in this context are acid catalysts. It may furthermore be advantageous to use a precursor of a catalyst so as to improve the selectivity of the process and to obtain the best lithographic performance. Such a precursor will convert to the actual catalyst upon heating i.e. the catalyst will be formed at least partially during the image-wise exposure. Suitable precursors of a catalyst are for example precursors that release an acid upon heating. Particular examples of suitable acid releasing catalyst precursors are diazoniums, sulfonium compounds, in particular benzylsulfonium compounds, as disclosed in e.g. EP 612065, EP 615233, and US 5.326.677, inorganic nitrates such as e.g. $Mg(NO_3)_2.6H_2O$ or organic nitrates such as guanidinium nitrate, ammonium nitrate or pyridinium nitrate as disclosed in EP 462763, WO 81/1755 and US 4.370.401, compounds that release a sulfonic acid such as 3-sulfolenes, e.g. 2,5-dihydrothio-thiophene-1,1-dioxides as disclosed in US 5.312.721, thermolytic compounds disclosed in GB 1.204.495, co-cristalin adducts of an amine and an volatile organic acid as disclosed in US 3.669.747, aralkylcyanoforms as disclosed in US 3.166.583, thermo-acids disclosed in EP 159725 and DE 3515176, squaric acid generating compounds as disclosed in US 5.278.031, acid generating compounds disclosed in US 5.225.314 and US 5.227.277 and RD

11511 of November 1973.

[0038] Depending upon the relative sensitivity of coagulation of the thermoplastic hydrophobic polymer particles versus cross-linking or image-wise release of a catalyst, either coagulation, cross-linking or release of a catalyst may occurr or several processes may occurr simultaneously. If one of the processes has not occurred or only to a minor extent a subsequent overall heating may complete the process so that lithographic performance may be improved thereby. Such overall heating step may be carried out subsequent to scan-wise exposure and/or subsequent to development. For example the scan-wise exposure may release a catalyst for a cross-linking reaction without causing coagulation and cross-linking. As a consequence, there will be no or little differentiation in the uniform coating to allow development. An overall heating of the uniform coating may then cause sufficient cross-linking to allow development. Subsequent to development a further overall heat treatment at a higher temperature may improve the hydrophobic properties of the image-parts by coagulation of the thermoplastic polymer particles.

[0039] Instead of the above hydrophobic thermoplastic polymer particles, it is also possible to use particles comprising polysiloxane. Upon coagulation as described above, highly ink-repellant and water repellant areas can be produced so that a subsequent development with an aqueous liquid or water may result in ink-repellant image-areas.

[0040] As a still further alternative, hydropobic polymer particles may be used that include cross-linkable groups. Such hydrophobic polymer particles need not be thermoplastic but can be insolubilised by a heat activated cross-linking.

[0041] Further coating liquids suitable for coating a heat sensitive uniform coating in connection with the present invention are disclosed in e.g. EP 625,728; US 5.340.699 and US 4.708.925. Still further coating liquids suitable for coating a heat sensitive uniform coating include a diazonium salt or a diazo resin and a light to heat converting substance. Upon heating, such coating may be cross-linked and become hydrophobic at the exposed parts so that by an aqueous development the non-exposed parts may be selectively removed.

[0042] A coating liquid for use in connection with the present invention is preferably packaged in a suitable form for transportation from e.g. the manufacturer to the customer. An example of a suitable package is e.g. a plastic bottle. The coating liquid may be contained in the package in a ready to use form or may be provided in a concentrated form requiring dilution before use. Further, the package may include only the active compounds of the coating liquid without its solvent so that before use these active compounds have to be dissolved.

[0043] Another method for providing the exposure drum with an imaging element may involv the coating of so-called switchable polymers or other compounds of which the ink accepting properties may be image-wise modified onto said base, as described in e.g. DE 19,612,927.

[0044] In addition to on-press coating, the imaging element suitable for use in connection with the present invention may also be a printing plate precursor comprising a support and a radiation sensitive layer which may be applied onto said support by coating one of the above mentioned coating liquids. Preferably said printing plate is a lithographic printing plate, though other types such as letterpress or flexographic plates are also suitable.

[0045] Examples of suitable photosensitive lithographic printing plate precursors are for example the silver salt diffusion transfer (hereinafter DTR) materials disclosed in EP-A-410500, EP-A-483415 and EP-A-423399, imaging elements having a photosensitive layer containing diazonium salts or a diazo resin as described in e.g. EP-A-450199, imaging elements having a photosensitive layer containing a photopolymerisable composition as described in e.g. EP-A-502562, EP-A-491457, EP-A-503602, EP-A-471483 or DE-A-4102173.

[0046] Alternatively a lithographic printing plate may be prepared from a heat mode recording material as a lithographic printing plate precursor. Upon application of a heat pattern in accordance with image data and optional development the surface of such heat mode recording material may be differentiated in ink accepting and ink repellent areas. When the heat pattern is applied by a light source as e.g. an infrared laser, plate precursor will include a substance capable of converting the light into heat, examples of which have been mentioned above. Heat mode recording materials that can be used for making a lithographic printing plate precursor are described in e.g. EP-A-573091, DE-A-2512038, FR-A-1473751, Research Disclosure 19201 of April 1980 or Research Disclosure 33303 of January 1992.

[0047] As supports for the above mentioned lithographic printing plates there are known metal supports such as e.g. aluminium and flexible supports such as e.g. paper or polyester film supports. A preferred support is a thin glass support as described in EP-A 716,339 and EP-A 808,722, said glass support being characterised by (i) a thickness smaller than 1.2 mm and more preferably smaller than 0.8 mm, (ii) a failure stress (under tensile stress) equal to or higher than 1×10^7 Pa and more preferably higher than 4×10^7 Pa and (iii) an elasticity modulus (Young's modulus) equal to or lower than 10×10^{10}Pa. Glass having the above properties can be rolled around a core such as an exposure drum without breaking. Said glass support is preferred for use in the present invention, not only because of the high tranparency of glass, but also because glass is characterised by a high dimensional stability and excellent resistance to chemicals.

[0048] In another suitable implementation of the present invention, the imaging element can be applied onto the exposure drum as a sleeve consisting of a

transparent support and further comprising a radiation sensitive layer. Said sleeve may be coated off-press with said radiation sensitive layer and then transported automatically ("on-line") to the exposure drum of a press according to the present invention. In still another embodiment, the transparent wall of the exposure drum may be used as said transparent sleeve and the exposure drum itself could be coated with a radiation sensitive layer in the above mentioned off-press, on-line configuration and then automatically transported to the press. The feature "printing press comprising means for coating a radiation sensitive composition" thus embraces embodiments wherein said coating means are not literally comprised within the press itself but are comprised in an apparatus which is coupled to said press via an automatic transport.

[0049] In a press according to the present invention, lithographic imaging elements are preferred that require no (wet) processing after exposure. Such materials contain a printing surface immediately after being exposed. However most imaging materials require a development step in order to yield a printing surface. This development may be a dry step, e.g. a printing plate precursor that works according to an ablation process may be developed after exposure by rubbing with a cotton pad to remove the ablated debris. In most cases said development step requires the treatment of the exposed imaging element with an aqueous solution, particularly an aqueous alkaline solution. Said processing solution is preferably applied onto the radiation sensitive layer of the imaging element while being mounted on the exposure drum. Means for applying said processing solution may be similar to the means for coating the radiation sensitive compositions mentioned above. In a preferred embodiment, the development is carried out by applying a fountain solution during the first runs of the printing job.

[0050] A preferred example of such printing plate precursors that require wet processing is a plate that works according to the DTR-process. A first type of such DTR plates comprise on a flexible support in the order given an optional base coat, a silver halide emulsion layer and an image-receiving surface layer. To obtain a lithographic plate from such a DTR precursor, the material is exposed and then developed in an alkaline processing liquid in the presence of a developing agent and a silver halide solvent. The plate surface may subsequently be neutralised with a neutralising agent. After this processing method the image-receiving layer has formed a printing surface carrying a silver image that is capable of accepting greasy ink in a printing process using a dampening liquid.

[0051] In another embodiment said DTR lithographic printing plate precursor may comprise in the order given on the hydrophilic surface of an aluminium support an image-receiving layer and a silver halide emulsion layer. To obtain a lithographic plate from said precursor the material is exposed and subsequently developed in an alkaline processing liquid in the presence of a developing agent and a silver halide solvent. The printing plate precursor is then treated to remove the layer(s) on top of the image-receiving layer. After processing the image-receiving layer will carry a printing surface.

[0052] In an alternative method, the latter material may be laminated on the exposure drum of a press according to the present invention, in such a way that the silver halide emulsion layer is facing the drum. Before or after the exposure, the support may be stripped away leaving the silver halide emulsion and the image-receiving layer on the exposure drum. After processing as described above, a printing surface is obtained which is facing away from the exposure drum.

Claims

1. A rotary printing press with an integrated image-setter, said press having a print station which comprises
   - means for producing a modulated radiation beam;
   - means for focussing the radiation beam;
   - means for deflecting the radiation beam;
   - a hollow cylinder having a wall with an outer surface for carrying an imaging element that is capable of becoming a print master upon exposure to the radiation beam;
   - means for applying ink onto said print master;
   - means for transferring the ink to a substrate;

   characterised in that the deflecting means are located inside the hollow cylinder and that the wall of the hollow cylinder consists of a material that is transparent with respect to the radiation beam.

2. A rotary printing press according to claim 1, wherein said print station further comprises a master cylinder and means for transporting the imaging element from the hollow cylinder to said master cylinder.

3. A rotary printing press according to claim 2, wherein said hollow cylinder is an impression cylinder.

4. A rotary printing press according to claims 1, 2 or 3, wherein said press comprises a plurality of print stations mounted around a single central impression cylinder that is common to each of said print stations.

5. A rotary printing press according to any of the previous claims further comprising means for coating or laminating a radiation sensitive composition onto the outer surface of the hollow cylinder.

6. A method for making a print master, said method comprising the steps of

(i) providing the outer surface of the wall of a hollow cylinder with an imaging element;
(ii) image-wise exposing said imaging element by the steps of

- producing a modulated radiation beam;
- focussing the radiation beam;
- deflecting the radiation beam towards said imaging element;

(iii) optionally developing the imaging element;
characterised in that the radiation beam is deflected from within said hollow cylinder and that the wall of the hollow cylinder consists of a material that is transparent with respect to the radiation beam.

7. A method according to claim 6 wherein the step of providing the outer surface of the wall of the hollow cylinder with an imaging element is carried out by coating or laminating a radiation sensitive composition onto the wall of the outer surface of the hollow cylinder.

8. A method according to claim 6 wherein the imaging element is a printing plate precursor comprising a support and wherein said printing plate precursor after exposure is transported from the hollow cylinder to a master cylinder.

9. A method according to claim 6 wherein the imaging element is a printing plate precursor comprising a support, said support being transparent with respect to the radiation beam.

10. A method according to claim 9 wherein the support is a glass support having a thickness lower than 1.2 mm and a failure stress (under tensile stress) equal to or higher than $1x10^7$ Pa and an elasticity modulus (Young's modulus) equal to or lower than 10×10^{10} Pa.

11. A method according to any of claims 6 to 10 wherein the radiation beam is a beam of infrared light and the imaging element comprises a substance capable of converting said infrared light into heat.

12. A method according to any of claims 6 to 11 wherein the imaging element requires no processing step and is ready for use immediately after exposure.

13. A method for printing comprising the steps of

(i) making a print master according to the method of any of claims 6 to 12;
(ii) applying ink onto the master;
(iii) transferring the ink to a substrate.

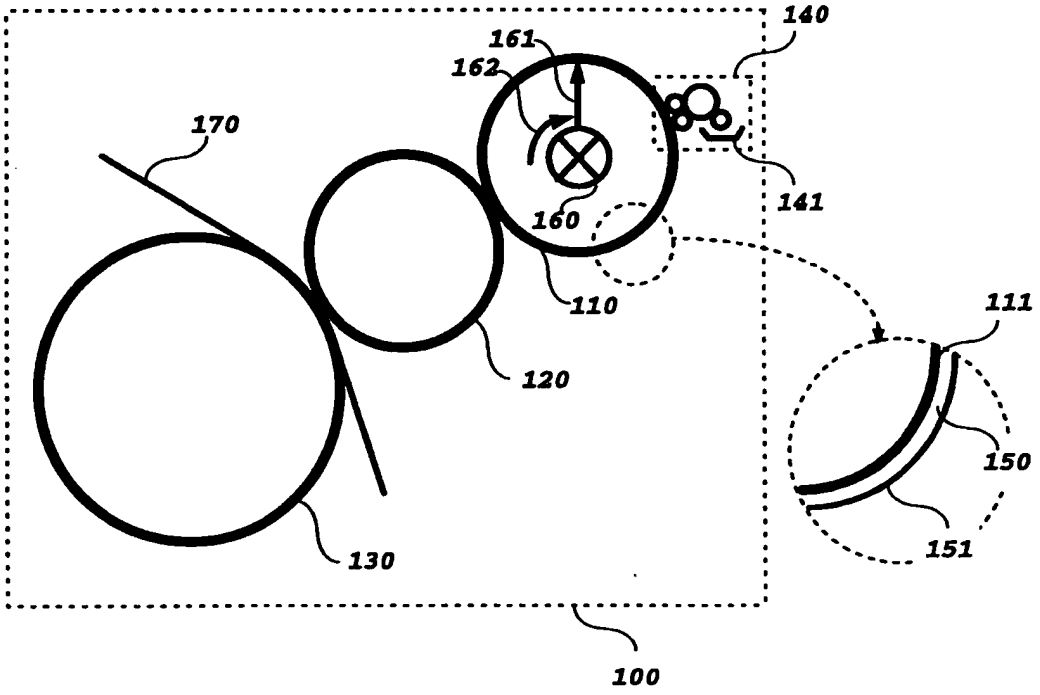
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Fig.1

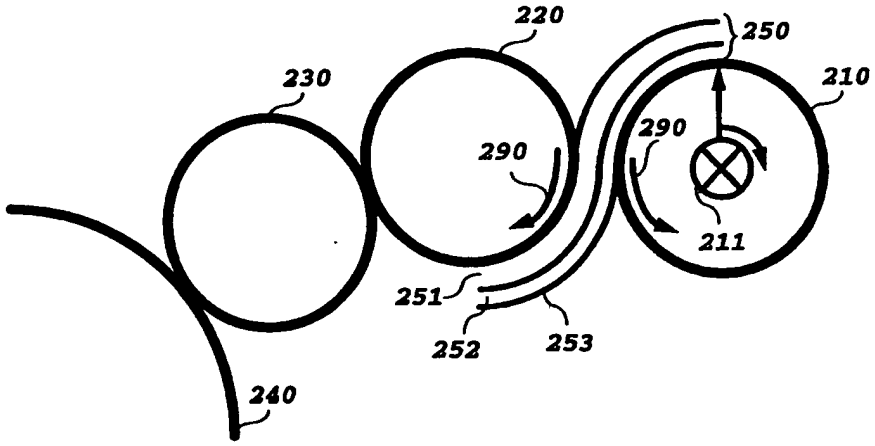
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Fig.2

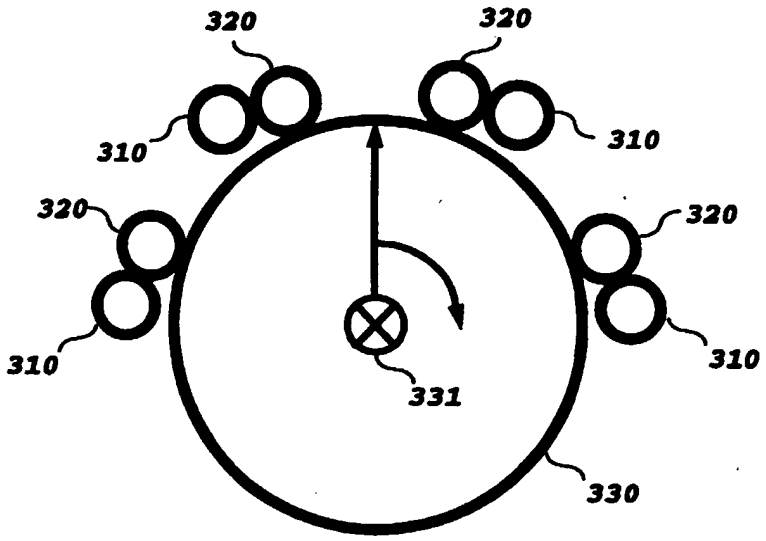

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 0651

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 580 394 A (PRESSTEK) 26 January 1994 * the whole document *	1,2,6,7, 11-13	B41F7/02
D,A	US 5 045 697 A (M.A.N.-ROLAND DRUCKMASCHINEN AKTIENGESELLSCHAFT) 3 September 1991		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41F
B41C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 August 1998	Loncke, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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